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ANALYSIS OF NETWORK BASED INTERFACE MANAGEMENT SYSTEM FOR LARGE SCALE CONTRUCTION PROJECTS

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ABSTRACT

Safety methods in the field of construction are a serious issue in the global construction industry, especially in large-scale construction projects. A conceptual framework of adopting a novel technology to aid in construction safety management is carried out in this project in order to improve the performance of safety management. The whole project consists of recognition of unsafe parameters in construction areas and safety training. A case study will be utilized to demonstrate the implementation of the safety management platform and assess its possibility and authority. It is anticipated that the safety management platform can effectively come to rescue in safety management and enhance the safety performance of various construction management systems and processes. It is well known that technology has been widely applied in several areas such as retail, logistics, supply chain management, security areas, and so on. It has delivered huge advantages in the above avenues through improving real-time information visibility and traceability. This project aims to investigate various scenarios that illustrate the uses of technology in construction project management. The research will be based on a brief summary of recent developments of technology in different industrial sectors including construction.

KEYWORDS: Safety Methods, Recent Developments of Technology, Real-Time Information Visibility

INTRODUCTION

On-site construction management is a serious component for the successful execution of large-scale construction projects. Accurate and timely understanding of on-site information about work tasks and construction resources facilitates management decisions toward improving construction productivity. However, it is challenging for site engineers to collect and share site information in real-time due to harsh construction conditions. The locations of materials, labor, and equipment, along with the current status of progress, are difficult to be understood at construction sites. These challenges necessitate the development of tools equipped with suitable sensing and communication capabilities to acquire and exchange construction information efficiently.

Efforts are being made to apply sensing technology to construction sites for automated data acquisition. Three-dimensional sensing technologies, such as total stations, Global Positioning System, Ultra Wide Band, laser scanning, and digital photogrammetry, are being studied for generation of as-built drawing. Radio Frequency Identification systems have been studied as material tracking tools for construction projects.

These pioneering efforts prove that advanced sensing technologies have the potential to substantially improve traditional on-site management processes. However, the full potential of sensing technologies can be achieved only when

the information obtained on site is effectively distributed and shared among project participants. The real-time project information can enable a range of project participants, including project managers, site engineers, and construction workers, to make informed decisions. In particular, the flow of information to the level of construction workers can generate a new breed of knowledge workers.

In recent years, construction information management has greatly benefited from advances in Information and Communications Technology (ICT) through increasing the speed of information flow, enhancing the efficiency and effectiveness of information communication, and reducing thecost of information transfer. Current ICT support has been extended to construction site offices. However, construction projects typically take place in the field where construction personnel have difficulty in gaining access to conventional information systems for their information requirements. The advances in affordable mobile devices, the increase in wireless network transfer speeds and the enhancement in mobile application performance, mean that mobile computing has a great potential to improve on-site construction information management.

Information Technology has been widely applied at different information management levels in the construction industry. However, the implementation of construction projects takes place on construction sites where personnel have difficulty in gaining access to conventional computer systems. Managers, engineers and other key personnel move frequently from site to site and from site offices to the sites.

There are requirements that a construction management system for site engineers should meet. First, the on-site construction management system should be capable of site monitoring to understand the current status of the construction project. Second, the system should provide information of work tasks for site engineers to effectively manage construction resources. Lastly, the system should have the function of real-time information sharing to facilitate efficient interaction among construction participants.

OBJECTIVE OF THE PRESENT WORK

Based on the above introduction, we now focus on the aim of the present work.

- To study the variation of the respondent organizations in the Indian construction industry as a function of the size of organizations.
- It is in our interest to carry out a detailed analysis of the percentage of office and site staff that has access to computers and related technological equipment.
- To identify the distribution of organizations for variable use of ICT.
- To tackle managerial and technical issues, both at the corporate office level and also at the user end (i.e. site) level.
- To analyze the data retrieved from the questionnaire survey.

MATERIALS AND METHODS

The research aim of the study reported in this work was to develop protocols for effective adoption of ICT for Building Project Management by Small and Medium Enterprises (SMEs) in the Indian construction industry. It required identification of the formal Project Management processes adopted and the extent of ICT adoption for these processes;

study of factors including perception based factors affecting ICT adoption and study of causal relationships between these factors. The study is in relation to SMEs, since they constitute a critical and major role in the construction supply chains.

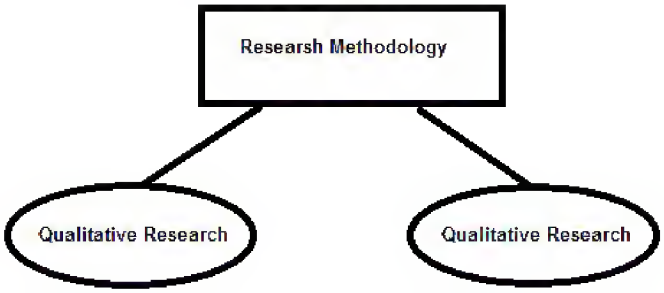

Figure 1: Breakdown of the Types of Research Methodology

Figure 1 shows the breakdown of the types of Research methodology. Some of the factors could be measured quantitatively, but some factors like people level factors required qualitative assessment. Thus, the research methodology divided the research into quantitative and qualitative research and the research focused on collecting and analyzing both, quantitative and qualitative data in the study in a sequential manner (sequential mixed methods approach). Such a methodology helps in using different methods for different purposes in the study and enables triangulation to take place at the results formulation stage. The purpose of this sequential mixed methods study was to start with pragmatic assumptions; obtain statistical, quantitative results from a broad sample of organizations to analyze or study research variables at industry and organization levels and then to follow up with selected organizations and projects to study the research variables at the levels of organization and people.

Figure 2: Relation between Industry, Organization and People

The relation between industry, organization and people is given in Figure 2. The component of the quantitative analysis stage of research conducted to assess extent of ICT adoption in the Indian construction industry for administrative processes as well as Project Management processes will be described in detail in this work. Data for quantitative analysis was collected through a questionnaire survey conducted in the Indian construction industry. Data analysis identified issues that require action at the three study levels of industry, organization and people and other issues that required qualitative study.

Objective of the Present Study

A research framework borrowing ideas from the manufacturing industry was proposed to guide the investigation in this study. In manufacturing, a Wireless Manufacturing Framework was developed to achieve a better working environment with real-time information visibility and traceability for improving the effectiveness of managerial decisions and operational efficiency.

These frameworks normally comprise of five layers from bottom to top: traceable objects with other auto-ID technologies, smart objects, smart gateway, shop-floor gateway, and enterprise application systems. Similar to borrowing the lean production idea from Toyota, frameworks in manufacturing may be applicable to construction. But the research reported herein focuses and how it as a fundamental part of the frameworks can be used in construction.

Questionnaire survey was conducted at the organization level. But the survey was conducted across India. Thus, the results can be generalized at the industry level. Above discussed analysis led to the identification of issues that require action at the levels of industry, organization and people.

RESULTS AND DISCUSSIONS

The research aim of the study reported in this paper was to develop protocols for effective adoption of Information and Communication Technologies (ICT) for Building Project Management by Small and Medium Enterprises (SMEs) in the Indian construction industry. It required identification of the formal Project Management processes adopted and the extent of ICT adoption for these processes; study of factors including perception based factors affecting ICT adoption and study of causal relationships between these factors. The study is in relation to SMEs, since they constitute a critical and major role in the construction supply chains. Some of the factors could be measured quantitatively, but some factors like people level factors required qualitative assessment.

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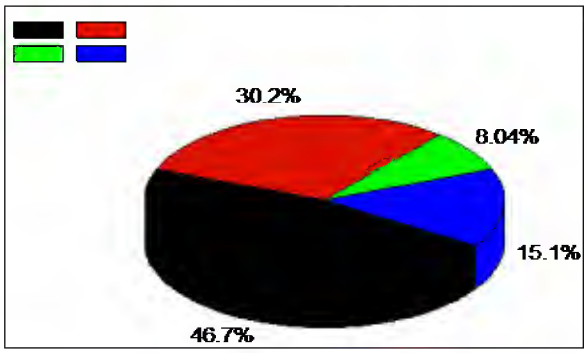

Figure 3: Distribution of Organizations (in %) for Variable Use of ICT

In Figure 3,

- The Black symbol represents ~46 % organizations extent of ICT adoption is organization specific and remains

preliminary same for all the projects.

- The Red symbol represents ~30 % organizations and it varies due to variable requirement of clients.
- The Green symbol represents ~8 % organizations. It varies due to ICT capability of associating project team organizations.
- The Blue symbol represents ~15 % organizations. It varies both the above factors have equal effects.

Effective adoption of ICT for Project Management requires collaborative use of ICT between different organizations. But, it was found that the collaborative use of ICT is less as compared to internal use of ICT within the organizations. Data was collected for communication methods utilized for each identified Project Management process. Communication methods were categorized as through hard copy, hard copy and e-mail and only e-mail with scores 1, 2 and 4 respectively. Communication was categorized into four groups:

- Within office
- Between office and site
- Between office and clients or consultants
- Between office and contractors or material suppliers.

Further, to represent the usage of multiple communication methods for a process, respondents could identify different communication methods utilized for different percentage of projects, through a five-point interval scale.

Data analysis also included study of perception based data as well as study of causal relationships between quantifiable factors. Qualitative stage of research included case study analysis and studied identified issues in depth. Triangulation of the results of all the research components led to the development of a benchmarking framework for measuring ICT adoption for building project management and protocols for enhancing effective adoption of ICT for Building Project Management by Small and Medium Enterprises (SMEs) in the Indian construction industry. Further research components and results are discussed by the authors in other supporting papers. As discussed earlier in the paper, literature review did not indicate any industry wide initiative in India to study ICT adoption by the construction industry. Thus, these results provide a guideline at the national level.

CONCLUSIONS

- A detailed study on the dependence of the respondent organizations in the Indian construction industry as a function of the size of organizations was carried out. We conclude that all the respondent organizations can be classified as Small and Medium Enterprise (SMEs).
- The choice of the different Small and Medium Enterprises (SMEs) taken in this study provided us adequate understanding of the collected data, analyses and discussion of the results.
- The distribution of organizations for variable use of Indian Construction sector was identified along a wide range of parameters. The results were found convincing, in satisfaction with Wilcoxon Signed ranks test, being nonparametric.
- The communication methods used in the present work plays a vital role in the determination of ICT adoption of

building construction projects.

- The need of questionnaire survey is very important in this work as it summarizes and presents a brief overview of the study done.

Increased urbanization, economic development, improved living standards, increased industrialization and infrastructure investments have led to high growth of the Indian construction industry. Projects that contain results like ours, can create a better life and living standards and can help in understanding the issues concerned of the Indian Construction Industry.

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